WEST

Generate Collection Print

L2: Entry 6 of 24 File: USPT Apr 24, 2001

US-PAT-NO: 6221259
DOCUMENT-IDENTIFIER: US 6221259 B1

TITLE: Process and catalyst for photocatalytic conversion of contaminants

DATE-ISSUED: April 24, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Kittrell; James R.	Amherst	MA		

US-CL-CURRENT: 210/748; 210/762, 210/763, 210/908, 210/909, 423/245.3, 423/247

CLAIMS:

What is claimed is:

1. A process for the photocatalytic oxidative destruction of contaminants from an oxygen containing fluid stream which comprises:

providing a photocatalyst comprising titanium in an amount of between about 0.001 wt % to about 2.0 wt %, zirconium in an amount of between about 0.001 wt % to about 2.0 wt %, and silica; and

passing said oxygen containing fluid stream over said photocatalyst while irradiating the photocatalyst with ultraviolet light of wave length less than or equal to about 400 nanometers to destroy said contaminants, wherein the amount of oxygen in the oxygen containing fluid stream is sufficient to substantially oxidize said contaminants.

2. A process according to claim 1 wherein said silica comprises silica gel and said titanium and zirconium are supported by said silica gel.

3. A process according to claim 1 or 2 wherein said catalyst further comprises a metal selected from the group consisting of platinum, palladium and mixtures thereof in an amount of between about 0.01 wt % to about 2.0 wt %.

4. A process according to claim 1 or 2 wherein said catalyst further comprises a metal selected from the group consisting of silver, gold and mixtures thereof in an amount of between about 0.01 wt % to about 2.0 wt %.

5. A process according to claim 1 or 2 wherein said catalyst further comprises a metal selected from the group consisting of platinum, palladium and mixtures thereof in an amount of between about 0.01 wt % to about 2.0 wt %, and a metal selected from the group consisting of silver, gold and mixtures thereof in an amount of between about 0.01 wt % to about 2.0 wt %.

6. A process according to claim 1 or 2 including passing said oxygen containing fluid stream over said photocatalyst such that the contact time of the fluid stream with said photocatalyst is between about 0.01 seconds to 10 minutes, wherein the contact time is defined as the ratio of the volume of the photocatalyst to the total volumetric flow rate of said fluid stream.

7. A process according to claim 6 wherein said fluid is gas.

8. A process according to claim 7 including passing said oxygen containing gas stream over said photocatalyst such that the contact time of the gas stream with said photocatalyst is between about 0.05 seconds to 1 minute, where the contact time is defined as the ratio of the volume of the photocatalyst to the total volumetric flow rate of said gas stream.

9. A process according to claim 7 including passing said oxygen containing gas stream over said photocatalyst such that the contact time of the gas stream with said photocatalyst is between about 0.1 seconds to 5.0 minute, where the contact time is defined as the ratio of the volume of the photocatalyst to the total volumetric flow rate of said gas stream.

10. A process according to claim 6 wherein said fluid stream is an aqueous stream.

11. A process according to claim 10 including passing said oxygen containing aqueous stream over said photocatalyst such that the contact time of the aqueous stream with said photocatalyst is between about 0.5 seconds to 5 minutes, where the contact time is defined as the ratio of the volume of the photocatalyst to the total volumetric flow rate of said aqueous stream.

12. A process according to claim 1 wherein the amount of oxygen in the oxygen containing fluid stream is present in an amount, with respect to said contaminants, of at least 2 times stoichiometric.

13. A process according to claim 1 or 2 wherein said contaminants are selected from the group consisting of volatile organic compounds (VOCs), chlorinated volatile organic compounds (CVOs), toxic air pollutants (TAPs), and mixtures thereof.

14. A process according to claim 1 or 2 wherein said contaminants are organic contaminants and include compounds of carbon and hydrogen.

15. A process according to claim 1 or 2 wherein the process is carried out under the following conditions: a temperature of between about 50.degree. F. to about 200.degree. F.; pressure of between about 0.1 to about 10 atm.

16. A process according to claim 1 or 2 wherein the process is carried out under the following conditions: a temperature of between about 70.degree. F. to about 150.degree. F.; pressure of between about 0.8 to about 1.5 atm.

17. A process according to claim 1 or 2 wherein the process is carried out under the following conditions: a temperature of .ltoreq.1000.degree. F.

18. A process according to claim 1 or 2 wherein the ultraviolet light has a wave length of between about 185 to about 375 nanometers.

19. A process according to claim 1 or 2 wherein the photocatalyst has relative UV light transmission of at least about 200 microwatts/cm.sup.2.

20. A process according to claim 1 or 2 wherein the ultraviolet light has an incident intensity on the exterior surface of the photocatalyst of at least about 0.1 mw/cm.sup.2.

21. A process according to claim 1 or 2 wherein the ultraviolet light has an incident intensity on the exterior surface of the photocatalyst of between. about 5 mw/cm.sup.2 to 500 mw/cm.sup.2.

22. A process according to claim 1 or 2 wherein the photocatalyst has the

follow physical properties:

pore volume.gtoreq.0.4 cm.sup.3 /g;

surface area.gtoreq.100 m.sup.2 /g; and

a water saturation capacity of .ltoreq.7 wt. % at 10% relative humidity air at 70.degree. F.

23. A process according to claim 2 wherein the photocatalyst has the follow physical properties:

pore volume preferred 0.4 to 1.5 cm.sup.3 /g;

surface area preferred 100 to 400 m.sup.2 /g; and

a water saturation capacity of .ltoreq.5 preferred at 10% relative humidity air at 70.degree. F.

24. A process according to claim 1 wherein the photocatalyst comprises titanium in an amount of between about 0.005 wt % to about 0.500 wt. % and zirconium in an amount of between about 0.005 wt. % to about 0.500 wt. %.

25. A process according to claim 1 wherein the photocatalyst comprises titanium in an amount of between about 0.008 wt % to about 0.080 wt. % and zirconium in an amount of between about 0.008 wt. % to about 0.080 wt. %.